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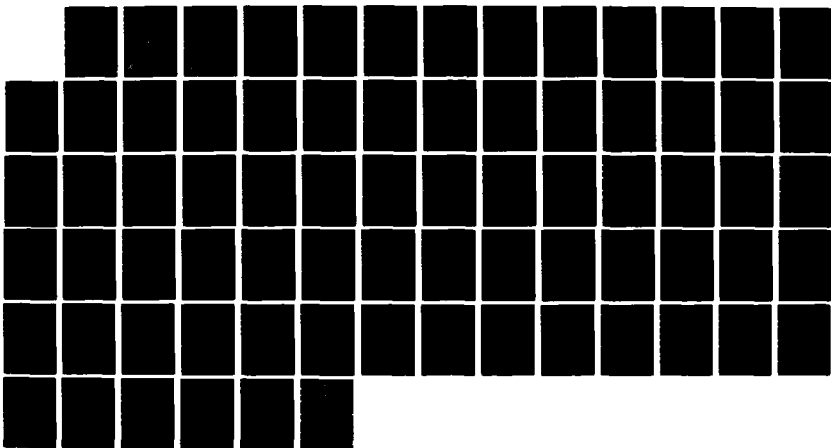
PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES FOR ASTRAL
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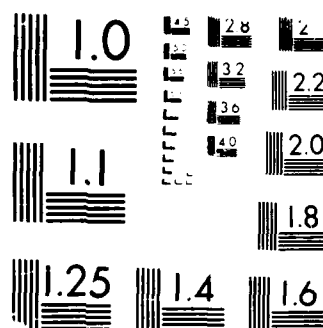
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PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES
FOR ASTRAL

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PROGRAMS TO PROVIDE DIAGNOSTIC CAPABILITIES
FOR ASTRAL

SAI-82-695-WA

February 1982

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Section 1
INTRODUCTION

This report documents three computer programs developed to provide ASTRAL users with more diagnostic capabilities. Basically the programs read data files generated by the ASTRAL propagation loss model and display the input. The programs were written for use on the Digital Equipment Corporation VAX 11/780 in FORTRAN utilizing standard CALCOMP plotting software. For each program this report will provide:

- A. Brief description of program
- B. Modifications made to ASTRAL
- C. Table of all input parameters
- D. Sample run
- E. Source language listing

Section 2

PROGRAM PLTSMDS

2.1 DESCRIPTION OF PROGRAM

The purpose of PROGRAM PLTSMDS is to provide the ASTRAL user with a plot of the modal transmission loss (dB) for each frequency/source depth combination and also the final transmission loss results calculated by ASTRAL.

It is a complete program. The total length is 16896 bytes. It does not require any temporary storage. The execution time obviously will vary with the number of f/ZS combinations. For the sample computer run, the total central processor (CP) time was 4.9 s.

The required input data are listed in table form (Section 2.3). The data fall into two groups: transmission loss as generated by ASTRAL and plot information.

Briefly, PROGRAM PLTSMDS reads the scaling factors for the x-y axes. If this information is omitted, the values last specified are used or, if never specified, default values are supplied. Next the title, minimum and maximum range (nm), and number of nm/inch are read. The axes are drawn and labeled. Finally the parameters specifying the exact frequency/source depth combination to be plotted are read in. The program is now ready to process the data file.

First, the header record is read. It contains the run date, receiver depth, and source and frequency values. This information is used to further entitle the plot. The program reads the data one record at a time. It singles out the modal transmission loss for the correct frequency/source

depth combination and stores the data in core. The final transmission loss results are also read and stored.

The modal transmission loss is plotted for all propagating modes. The points are connected with a solid line and labeled with mode number. The standard transmission loss output is plotted with a dotted line. All the actual plotting instructions are contained in subroutine DLINE3.

When the plot is complete, PROGRAM PLTSMDS cycles back to the beginning of the program to allow the user to plot another frequency/source depth combination for the same or a different track. There is no limit to the number of plots which may be generated.

2.2 MODIFICATIONS TO ASTRAL

PROGRAM PLTSMDS requires a binary unformatted data file containing the modal transmission loss and standard ASTRAL transmission loss results. The data are written on FILE 1. Changes have been made in DRIVER and subroutine INTSUM.

2.2.1 Program DRIVER

Several minor changes have been made to this main driver. It writes the header record for FILE 1. The statement has the form:

```
WRITE(1)(TITLE(L),L=1,8),WHEN,ZR,NZS,(ZS(L),L=1,
NZS),NF,(F(L),L=1,NF)
```

TITLE is obviously the title array and WHEN a variable containing the run date. The receiver depth is ZR. Array ZS

contains NZS source depth values and array F the NF frequency values. Most of this information is available in DRIVER through labeled common /RECVFRQ/ and /SRCFRQ/. The title is defined in a data statement and WHEN is obtained through a call to subroutine DATE.

An end-of-file is written on FILE 1 signaling the end of the modal transmission loss data for one track. The statement is

```
END FILE 1
```

After subroutine TLOUT has been called to output the transmission loss results, the same results are written out to FILE 1 and terminated with an end-of-file. The set of statements are:

```
DO 105 LPLOT = 2, IR
WRITE(1) RANGE(LPLOT), ((AMPM(LPLOT,KPLOT,MPLOT),
KPLOT=1,NZS),MPLOT=1,NF)
105 CONTINUE
END FILE 1
```

Array AMPM contains the transmission loss values at range (RANGE). There are IR range steps. This information is contained in labeled commons /RANGE/ and /TLINT/.

All of these changes have been incorporated into the track loop which means they will be repeated for each track. Two files are written for each track processed by the ASTRAL model.

2.2.2 Subroutine INTSUM

Subroutine INTSUM attenuates the amplitude of each mode and sums the product of this attenuated amplitude and the source eigenfunction value. The result is divided by the range. Several changes have been made to store the product for each mode at each range step.

The first change was to define a new array SMTL to store the modal transmission loss. It is dimensioned SMTL (3,6,25) since there is a maximum of three source depths, six frequencies, and twenty-five modes.

The entire array is initialized to value 999. Subroutine INTSUM will only generate values for modes M1 through M2, the first and last propagating modes. The 999 value will signal PROGRAM PLTSMDS that all the real data have been processed. The coding used to initialize array SMTL is

```
DO 700 J=1,NZS
DO 700 N=1,NF
DO 700 M=1,25
700  SMTL(J,N,M)=999.
```

where NZS is the number of the source depths, NF the number of frequencies and 25 is the maximum number of modes.

The statements incorporated to calculate the modal transmission loss with a maximum value TLMAX and store the results in array SMTL are:

```
SMINT=PHIRC(N,M)*PHIM(J,N,M)*R1
IF(SMINT.LE.AMPMIN)GO TO 41
SMTL(J,N,M)=-10.*ALOG10(SMINT)+DBCONV
```

```

GO TO 40
41    SMTL(J,N,M)=TLMAX

```

Array PHIRC contains the attenuated mode amplitude values and PHIM the source eigenfunction values. The minimum amplitude is defined by AMPMIN, the conversion factor to dB re 1 yd by DBCONV and the maximum transmission loss by TLMAX. All of these variables are in labeled common /MODEMS/ and /CONV/.

Finally the results are written out to FILE 1. The coding is:

```

DO 701 N=1,NF
WRITE(1)RANGE(IR),N,((SMTL(J,N,M),M=1,25),
J=1,NZS)
701  CONTINUE

```

The array RANGE containing the range at each range step is found in labeled common /RANGES/.

2.3 INPUT TO PROGRAM PLTSMDS

FILE ACCESS NAME FOR005 (FILE 5)

RECORD 1

FORMAT (5F10.2)

TLMIND	Minimum transmission loss (dB) - default is 60.0.
TLMAXD	Maximum transmission loss (dB) - default is 130.0.
TLINC	Transmission loss increment (dB/inch) - default is 10.0.

RECORD 1 (continued)

FORMAT (5F10.2)

FX Scale factor for x-axis - default is 1.0.

 If FX=0.5, tick marks drawn every 0.5 inches
 and x-axis compressed by 50%.

 If FX=3.0, tick marks drawn every 3.0 inches
 and x-axis length is tripled.

FY Scale factor for y-axis - default is 1.0.
 Scales y-axis same as FX scales x-axis.

RECORD 1 MAY BE OMITTED. If omitted the program will default
to last specified value or to default values if never
specified.

RECORD 2

FORMAT (3F10.2,10A4)

RMIN Minimum range (nm).

RMAX Maximum range (nm).

PSC Scale factor - number of nm/inch.

TITLE(10) Title of plot (40 characters).

RECORD 3

FORMAT (2A4,2X,3I5)

MODEL Set to SMODES. NO CHOICE. MUST BE
 SPECIFIED.

ITRK Number of track to be read on FILE 1 as
 processed by ASTRAL.

INDEX Index of frequency array in ASTRAL (not
 actual frequency value).

NOSRC Index of source depth array in ASTRAL (not
 actual source depth value).

RECORD 4FORMAT (2A4,2X,3I5)

MODEL Set to TL. NO CHOICE. MUST BE SPECIFIED.

ITRK Number of track.

INDEX Index of frequency array in ASTRAL.

NOSRC Index of source depth array in ASTRAL.

Entire sequence of cards may be repeated for as many plots as desired.

FILE ACCESS NAME FOR001 (FILE 1)
(Unformatted, binary data file written by ASTRAL)

RECORD 1

TITLE(8) Set to ASTRAL TRANSMISSION LOSS DATA FILE.

RDATE Date of ASTRAL run (character*9 format).

R Receiver depth (ft).

NZS Number of source depths (≤3).

ZS(3) Source depth values (ft).

NDF Number of frequencies (≤6).

DF(6) Frequency values.

RECORD 2

RANGE Range (nm).

N Index of frequency value.

SMTL(J,N,M) Modal transmission loss (dB) for all J
 source depths and M modes at frequency
 DF(N).

RECORD 2 is repeated for each of the NDF frequencies at each range step. Each record contains the modal transmission loss for all source depths at the specified frequency.

EOF End-of-file signaling end of modal transmission loss for this track.

Record 1

RANGE(J) Range (nm) at range step J.

AMPM(J,K,M) Transmission loss (dB) for each frequency/
 source depth combination at each range step
 J.

RECORD 1 will be repeated for each range step.

EOF End-of-file to signal end of transmission loss data for this track.

NOTE: There are two files written onto the binary, data file for each track processed by the ASTRAL transmission loss model. The entire sequence of records is repeated for each track.

2.4 SAMPLE RUN

INPUT DATA FOR005 (FILE 5)

100	RC.	150.	10.	1.0	1.0
200	0.	1250.	100.	SAMPLE RUN FOR PGM PITSNDS	
300	SMODES	1	1	1	
400	TL	1	1	1	

INPUT DATA FOR001 (FILE 1)

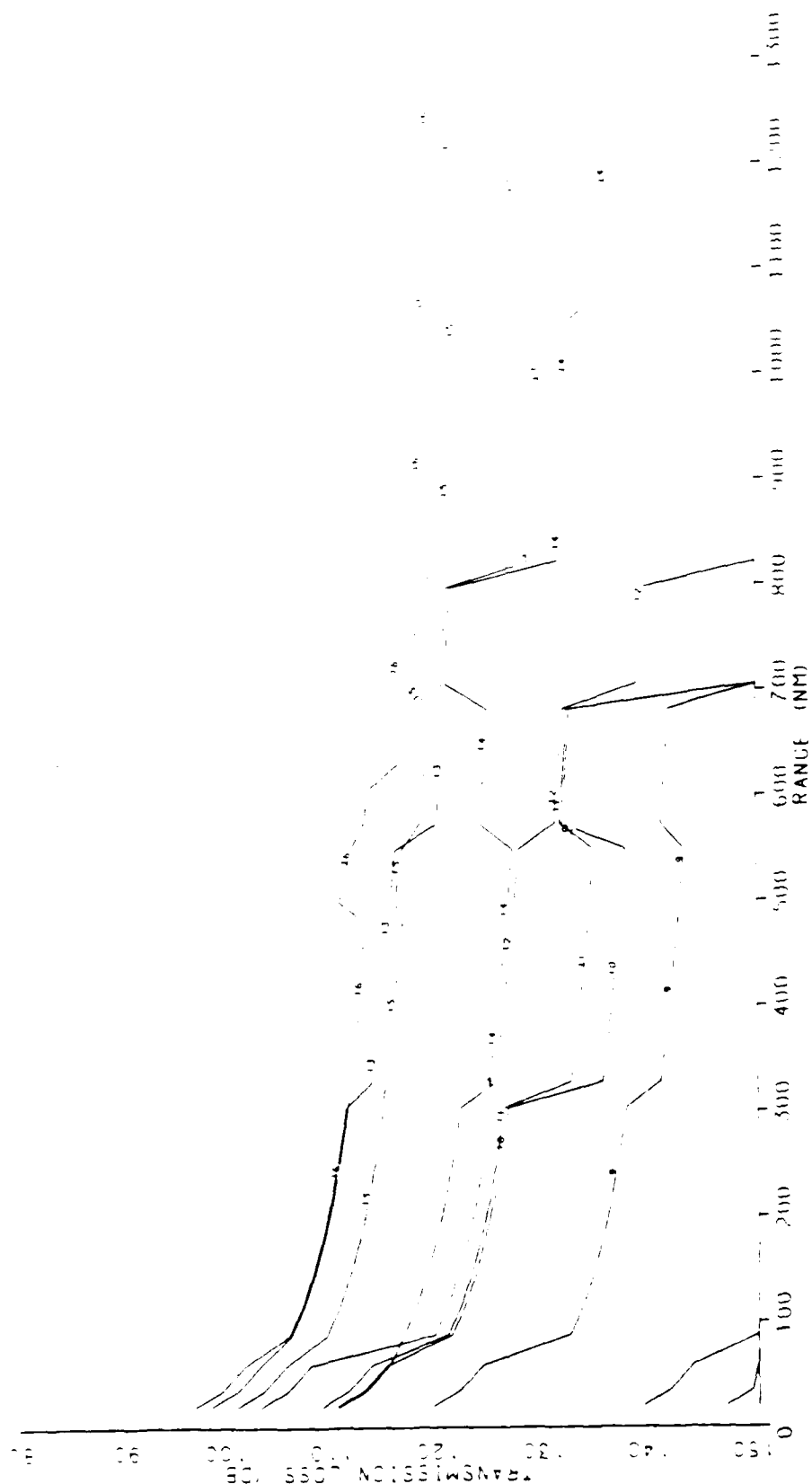
FILE 1 was generated by the ASTRAL propagation loss model using the following input.

3800	2624.67	4860.24	3280.84	4860.56	4921.26	4872.38	6561.68	4893.37
3900	9847.52	4942.91	16404.20	5057.74	32808.40	5364.17		
4000	0.00							
4100	0.00	5018.37	410.10	5019.36	656.17	4994.42	984.75	4983.92
4200	1968.50	4920.28	2296.59	4889.44	2624.67	4874.02	3280.84	4863.52
4300	3937.01	4864.83	4921.26	4870.08	6561.68	4891.08	9842.52	4942.91
4400	16404.20	5057.74	32808.40	5364.17				
4500	0.00							
4600	0.00	5020.34	98.43	5021.00	246.06	5010.83	656.17	4960.63
4700	1312.34	4894.36	1640.42	4874.34	1968.50	4861.22	2952.76	4853.67
4800	3608.92	4859.25	6561.68	4893.37	9842.52	4942.91	16404.20	5057.74
4900	32808.40	5364.17						
5000	0.00							
5100	0.00	5028.87	246.06	5033.14	492.13	4999.67	656.17	4992.45
5200	1312.34	4982.28	1640.42	4966.21	2624.67	4885.50	2952.76	4877.62
5300	3937.01	4867.78	4921.26	4873.03	6561.68	4893.04	9842.52	4943.24
5400	16404.20	5060.04	32808.40	5364.17				
5500	0.00							
5600	400	30.00						
5700	2	5						
5800	60.00	800.00						
5900	35.00	50.00	100.00	200.00	400.00			
6000	25							
6100	FFFF	0						
6200	2	0	2	0	1			
6300	1	2964.00	0	0.0000	0.0000	0.0000		
6400	2964.00							
6500	-18535							
6600	18.54							
6700	1							
6800	31							
6900	1250.00	-0.00846	-1					
7000	0	18.54						
7100	R							

7200	0.00	2964.00	0	.70	3000.00	0	.90	3600.00	0
7300	1.10	4200.00	0	2.30	6000.00	0	5.30	9000.00	0
7350	10.43	13654.86	3	18.54	15967.85	3			
7400	1	0.00	2388.45						
7500	1	2.32	4593.18						
7600	1	10.43	13654.86						
7700	1	18.54	15967.85						
7800	1	34.77	17083.33						
7900	2	59.10	17385.17						
8000	2	172.73	18287.40						
8100	3	302.85	18963.25						
8200	3	376.22	17992.13						
8300	3	408.89	16955.38						
8400	3	441.59	15846.46						
8500	3	449.77	15305.12						
8600	3	466.14	14412.73						
8700	3	482.52	13674.54						
8800	3	498.92	13441.60						
8900	3	539.95	14274.93						
9000	4	548.17	14537.40						
9100	4	597.53	14852.36						
9200	4	605.89	16043.31						
9300	5	681.07	16820.87						
9400	5	729.81	17818.24						
9500	6	796.34	18510.50						
9600	6	846.42	19143.70						
9700	6	997.77	19757.22						
9800	6	1006.23	16781.50						
9900	6	1014.70	18664.70						
10000	6	1025.36	19133.86						
10100	7	1048.62	19570.21						
10200	7	1185.29	16679.79						
10300	7	1193.88	18448.16						
10400	7	1202.49	18454.72						

COMPARISON FOR FOLIOLETTES

FILE	FREQUENCY	SOURCE	WAVELENGTH	DATE
FL	35.0 HZ	60.0 FT	296.4.0 FT	19 JAN 83
FL	35.0 HZ	60.0 FT	296.4.0 FT	19 JAN 83




```

12100 C      IF FACTX, FACTY LEFT BLANK, DEFAULTS TO PRIOR VALUE.
12200 C
12300 31      READ(LC,32,END=1000,ERR=33)TLMIND,TLMAXD,TLINC,FX,FY
12400 32      FORMAT(AF10.2)
12500      GO TO 35
12600 33      BACKSPACE 5
12700      GO TO 37
12900 C
13000 35      CONTINUE
13100      IF(FX.EQ.0.) FX=FACTX
13200      IF(FY.EQ.0.) FY=FACTY
13300      FACTX=FX
13400      FACTY=FY
13500      IF(TLMIND.EQ.0.) .AND. TLMAXD.EQ.0.) GO TO 37
13600      TLMIN=TLMIND
13700      TLMAX=TLMAXD
13800      TLSC=-TLINC
13900 C
14000 C      CHANGE AXIS SCALING IF AXIS TOO LONG.
14100      IF( (.NOT. METRIK) .AND. (TLMAX.GT.(TLMIN-8.*TLSC/FACTY)))
14200 *      TLMAX=TLMIN+TLINC*8.
14300      IF( (METRIK) .AND. (TLMAX.GT.(TLMIN-10.*TLSC/FACTY)))
14400 *      TLMAX=TLMIN+TLINC*10.
14500 *****
14600 C
14700 C      CARD (3<--RANGE-AXIS CARD ***NECESSARY FOR EACH SET OF AXES.***
14800 C      IF CARD UNACCEPTABLE TO READ, INPUTS ARE IN ERROR--STOP.
14900 37      CONTINUE
15000      READ(5,60,END=1000,ERR=63) RMIN,RMAX,RSC,(TITLE(I),I=1,10)
15200 60      FORMAT (3F10.2,10A4)
15300 C
15400      GO TO 65
15500 C
15600 C      IF READ ERROR, PRINT MESSAGE AND STOP
15700 C
15800 63      PRINT 64

```



```

15900 64 FORMAT('+++++ READ ERROR WAS FATAL -- CHECK THE INDICATED
16000 + CARD ++++++')
16100 GO TO 1000
16200
16300 C
16400 65
16500 C
16600 SIZEF IS HEIGHT OF NUMBERS, SIZEF IS WIDTH (IN INCHES)
16700 XSC=RSC/FACTX
16800 YSC=TLSC/FACTY
16900 SIZEF=.14
17000 SIZEW=.12
17100 MAG=-1
17200
17300 C
17400 C
17500 C
17600 C
17700 C
17800 C
17900 C
18000 C
18100 C
18200 C
18300 C
18400 C
18500 C
18600 C
18700 C
18800 C
18900 C
19000 C
19100 C
19200 C
19300 C
19400 C
19500 C
19600 C
19700 C
19800 C
19900 C
20000 C
20100 C
20200 C
20300 C
20400 C
20500 C
20600 C
20700 C
20800 C
20900 C
21000 C

```

```

CONTINUE
SIZEF IS HEIGHT OF NUMBERS, SIZEF IS WIDTH (IN INCHES)
XSC=RSC/FACTX
YSC=TLSC/FACTY
SIZEF=.14
SIZEW=.12
MAG=-1

*****
PLOT X AXIS
NLEN=(RMAX-RMIN)/RSC+.5
XLEN=NLEN*TWOCH
CALL PLOT(0.,-.1,2)
NUM=RMTN
CALL NUMRER(-.12,-.3,SIZEB,NUM,0.,MAG)
CALL PLOT(0.,0.,3)
NLEN=(RMAX-RMIN)/RSC+.5
DO 150 I=1,NLEN
NUM=NUM+RSC
X=FLOAT(I)*TWOCH*FACTX
CALL PLOT(X,0.,2)
CALL PLOT(X,-.1,2)
CALL NUMRER(X,-.12,-.3,SIZEB,NUM,0.,MAG)
CALL PLOT(X,0.,3)
150 CONTINUE
XLEN=X
NCH=10
ASTART=(X-NCH*SIZEW)*.5
CALL SYMRL(ASTART,-.5,SIZEB,TTLF,0.,NCH)
2 CALL PLOT(0.,0.,3)
( END X-AXIS )

```

```

21100 C *****
21200 C
21300 C
21400 C
21500 C
21600 C
21700
21800
21900
22000
22100
22200
22300
22400
22500
22600
22700
22800
22900
23000
23100
23200
23300
23400
23500
23600
23700
23800
23900
24000
24100
24200
24300
24400
24500
24600
24700

PLOT Y AXTS
MAG = -1

CALL PLOT(-.1,0.,.2)
NUM=TLMAX
CALLNUMBER(-.16,-.12,SIZE,NUM,90.,MAG)
CALL PLOT(0.,0.,.3)
NUM=(YF-YI)/TUSC+.5

DO 200 I=1,NLEN
  NUM=NUM+TUSC
  Y=FLOAT(I)*TWOCM*FACTY
  CALL PLOT(0.,Y,2)
  CALL PLOT(-.1,Y,2)
  CALL NUMBER(-.16,Y-.12,SIZE,NUM,90.,MAG)
  CALL PLOT(0.,Y,3)
200 CONTINUE
  YLEN=Y
  NCH=22
  ASTRT=(Y-NCH*SIZE)*.5
  CALLSYMBOL(-.36,ASTRT,SIZE,22HTRANSMISSION LOSS (DB) ,90.,NCH)
  (END Y AXIS)

*****
WRITE TITLE AND LABEL HEADINGS
CALL SYMBOL(.5,9.1,.21,TITLE,0.,40)
FNCODE(63,225,ICAP)
FORMAT(7X,5HTITLE,6X,9HFREQUENCY,6X,6HSOURCE,5X,6HRECEIVER,3X,
* 9HMIN DATE )
CALL SYMBOL(.0,5.8,8,SIZE,ICAP,0.,63 )
CAPH=.6
CAPH1=CAPH
TSYM=2
225

```

```

24800 C *****
24900 C
25000 C 250 IER=0
32800 C *****
32900 C
33100 C
33800 C
33900 C 255 READ(5,255,END=1000)MODEL,IFILE,INDEX,NOSRC
33950 C 255 FORMAT(2A4,2X,3I5)
33975 C IFILE--# OF TRACK TO BE PROCESSED.
33987 C INDEX--INDEX OF FRFQ ARRAY
34000 C NOSRC--INDEX OF SOURCE ARRAY
35400 C IOUT=3
35500 C 260 GO TO 270
35600 C
36600 C
36650 C 265 AHFAD=XLEN+6.0
36675 C CALL PLOT(AHFAD,0,-3)
36687 C GO TO 50
36700 C *****
36800 C GET THE FILE HEADER RECORD AND WRITE SURTITLE FOR THIS CURVE
36900 C 270 INSK=(IFILE#2)-2
37000 C ICURVE=ICURVE + 1
37100 C IF(KCURVE.NE.0) ICURVE=KCURVE
37200 C IF(ICURVE.GT.10) ICURVE=1
37300 C NLI=NLINF(ICURVE)
37400 C NSP=NSPACE(ICURVE)
37500 C NSH=NSHORT(ICURVE)
37600 C NLN=NLONG(ICURVE)
37650 C TF(MODEL(1),FO,4HT, )GO TO 290
37700 C
37800 C CHECK WHICH MODEL THIS IS AND GO TO THE APPROPRIATE PLACE
37900 C
38100 C REWIND 1
38102 C TF(INSK,FO,0)GO TO 700
38104 C DO 10 I=1,INSK
38106 C 5 CONTINUE
38108 C

```

```

38110 READ(1,FND=10)
38112 GO TO 5
38114 CONTINUE
39100 C
39600 C
39650 700 READ(1)(T,TL,F(I),I=1,8),RDATE,R,NZS,(ZS(I),L=1,NZS),
39675 1NDF,(DF(I),L=1,NDF)
39687 FRFO=DF(INDEX)
39690 II=0
39693 S=ZS(NNSRC)
40700 LAL=34 FT
41400 290 ENCODE(65,310,ICAP) MODEL,FREQ,S,LRL,P,LRL,RDATE
41500 305 FORMAT(7X,2A4,1X,FR,1,3H HZ,F9.1,A3,F10.1,A3,3X,A)
41900 310 CALL DLINER(-0.1,CAPH1+0.07,NLI,NSP,NLO,NSH)
42000 CALL DLINER(1.00,CAPH1+0.07,NLI,NSP,NLO,NSH)
42100 CALL SYMROL(0.5,CAPH1,SIZE,ICAP,0.,65)
42200 CAPH1=CAPH1-.2
42300 C (END OF HEADER READING AND WRITING)
42350 IF(MODFL(1).EQ.4HTI) GO TO 265
42400 C *****
42475 907 II=II+1
42487 908 READ(1,END=949)RANGE(II),IFREQ,((SMTL(J,M),M=1,25),
42493 1J=1,NZS)
42496 IF(IFREQ.NF.INDEX)GO TO 908
42498 DO 902 M=1,25
42499 902 TLPLNT(II,M)=SMTL(NNSRC,M)
42500 GO TO 907
42525 949 NR=II-1
C NOW PLOT THE CURVE. LOOP ON ALL POINTS ON TAPE 1
DO 400 II=1,NR
READ(1)XPNG,((SMTL(N,J),N=1,NZS),J=1,NDF)
TLPLNT(II,26)=SMTL(NNSRC,INDEX)
CONTINUE
M=0
400 400 II=3
M=M+1
IF(M.GT.26)GO TO 250
IF(M.NF.26)GO TO 401
NLI=NLTHF(2)

```

42785		NSP=NSPACE(2)	
42787	401	II=1	
42790		FPN=M	
42793		IEND=10000	
42800		OLDX=0	
42900		OLDY=0	
43000		INCH=0	
43100		XTOP=(XF-XI)/XSC	
43200		YTOP=(YF-YI)/YSC	
43300	C	INITIAL POINT	
43400		XA=RANGE(II)	
43450		TL=TLPL0T(II,M)	
43475		IF(TL.GT.900.)GO TO 998	
44100		X=(XA-RMIN)/XSC	
44200		Y=(TL-YI)/YSC	
44300	C	SECOND POINT	
44400		II=II+1	
44450		IF(II.GT.NR)GO TO 998	
44475		XA=RANGE(II)	
44487		TL=TLPL0T(II,M)	
44493		IF(TL.GT.900.)GO TO 998	
45100		X1=(XA-RMIN)/XSC	
45200		Y1=(TL-YI)/YSC	
45300		XYINCH=0	
45400		DELX=X	
45500		DELY=Y	
45600		IF(X) 1050,1070,1060	
45700	1050	XCH=-1	
45800		XNEW=0	
45900		GO TO 1075	
46000	1060	IF(X-XTOP) 1070,1070,1065	
46100	1065	XCH=1	
46200		XNEW=XTOP	
46300		GO TO 1075	
46400	1070	XCH=0	
46500		XNEW=X	
46600	1075	IF(Y) 1080,1095,1085	
46700	1080	YCH=-1	
46800		YNEW=0	
46900		GO TO 1100	
47000	1085	IF(Y-YTOP) 1095,1095,1090	

```

47100 1090 YCH=1
47200 YNEW=YTOP
47300 GO TO 1100
47400 1095 YCH=0
47500 YNEW=Y
47600 1100 CONTINUE
47700 NXCH=XCH
47800 NYCH=YCH
47900 IF(DFLX)1130,1110,1130
48000 1110 IF(DFLY)1130,1120,1130
48100 1120 INCH=1
48200 1130 CONTINUE
48300 IEND=10000
48400 GO TO 1150
48500 1140 IEND=1
48600 C
48700 C BEGIN LOOP ON DATA POINTS FOR THIS CURVE--UP TO 10,000 OF THEM
48800 C
48900 1150 DO 1600 I=1,IEND
49000 IF(INCH)1300,1175,1300
49100 1175 IF(XCH)1190,1180,1190
49200 1180 IF(YCH)1230,1185,1230
49300 C
49400 C IF POINT IN RANGE, PLOT IT, SET FLAG FOR SKIPPING THE INTERPOLATION
49500 C OF WHERE THE NEXT LINE WILL COME IN ROUNDS, AND SKIP THE LOOP
49600 C FOR INTERPOLATING WHERE THIS LINE GOES OUT OF BOUNDS (SINCE IT WON'T)
49700 C
49800 1185 CONTINUE
49900 IF(IOUT.FQ.2) CALL DLINE2(X ,Y ,NLI,NSP,NLO,NSH)
50000 IF(IOUT.FQ.3) CALL DLINE3(X ,Y ,NLI,NSP,NLO,NSH)
50100 XYINCH=1
50200 GO TO 1300
50300 1190 CONTINUE
50400 C
50500 C DRAW AN INTERPOLATED LINE TO THE GRAPH EDGE IF THIS POINT IS OUT OF RANGE
50600 C
50700 1200 IF(DFLX) 1205,1220,1205
50800 1205 YPL=DELY/DFLX*(XNEW-OLDX)+OLDY

```

```

50900 IF(YPL) 1215,1270,1210
51000 1210 IF(YPL-YTOP) 1270,1270,1215
51100 1215 IF(DELX) 1220,1300,1220
51200 1220 XPL=DELX/DELY*(YNEW-OLDY)+OLDX
51300 1225 IF(XPL) 1300,1275,1225
51400 1225 IF(XPL-YTOP) 1275,1275,1300
51500 1230 CONTINUE
51600 IF(XCH-OXCH) 1235,1232,1235
51700 1232 IF(XCH)1300,1235,1300
51800 1235 IF(YCH-OYCH) 1240,1236,1240
51900 1236 IF(YCH)1300,1240,1300
52000 1240 IF(DELX) 1245,1260,1245
52100 1245 XPL=DELX/DELY*(YNEW-OLDY)+OLDX
52200 1250 IF(XPL) 1255,1275,1250
52300 1250 IF(XPL-YTOP) 1275,1275,1255
52400 1255 IF(DELX) 1260,1300,1260
52500 1260 YPL=DELX/DELY*(XNEW-OLDX)+OLDY
52600 1265 IF(YPL) 1300,1270,1265
52700 1265 IF(YPL-YTOP) 1270,1270,1300
52800 1270 XPL=XNEW
52900 GO TO 1280
53000 1275 YPL=YNEW
53100 1280 CONTINUE
53200 IF(OUT.FQ.3) CALL DLINE3(XPL,YPL,NLI,MSP,NLO,NSH)
53300 IF(OUT.FQ.2) CALL DLINE2(XPL,YPL,NLI,MSP,NLO,NSH)
53400 1300 CONTINUE
53500 OXCH=XCH
53600 OYCH=YCH
53700 DELX=X1-X
53800 DELY=Y1-Y
53900 IF(DELX)1310,1305,1310
54000 1305 IF(DELX)1310,1306,1310
54100 1306 INCH=1
54200 X1NEW=XNEW
54300 Y1NEW=YNEW
54400 GO TO 1500
54500

```

C

```

54600 C DETERMINE WHETHER X (OR Y) IS TO LEFT OF (ABOVE), TO RIGHT OF (BELOW),
54700 C OR IN BOUNDS OF GRAPH, AND SET FLAGS AND INTERPOLATING VALUES ACCORDINGLY
54800 C
54900 1310 IF(X1)1312,1320,1314
55000 1312 XCH=-1
55100 X1NEW=0
55200 GO TO 1321
55300 1314 IF(X1-XTOP)1320,1320,1316
55400 1316 XCH=1
55500 X1NEW=XTOP
55600 GO TO 1321
55700 1320 XCH=0
55800 X1NEW=X1
55900 1321 IF(Y1)1322,1326,1324
56000 1322 YCH=-1
56100 Y1NEW=0
56200 GO TO 1328
56300 1324 IF(Y1-YTOP)1326,1326,1325
56400 1325 YCH=1
56500 Y1NEW=VTOP
56600 GO TO 1328
56700 1326 YCH=0
56800 Y1NEW=Y1
56900 1328 CONTINUE
57000 INCH=0
57100 C
57200 C INCH IS A FLAG FOR 2 IDENTICAL POINTS OR 2 POINTS OUT ON THE SAME SIDE
57300 C
57400 IF(OXCH)1332,1330,1332
57500 1330 XNEW=X1NEW
57600 1332 IF(OYCH)1336,1334,1336
57700 1334 YNEW=Y1NEW
57800 1336 IF(XCH-OXCH)1340,1338,1340
57900 1338 IF(XCH)1344,1340,1344
58000 1340 IF(YCH-OYCH)1346,1342,1346
58100 1342 IF(YCH)1344,1346,1344
58200 1344 INCH=1
58300 GO TO 1500

```



```

58400 C
58500 1346 CONTINUE
58600 C IF THIS POINT OUT OF RANGE AND NEXT POINT IN RANGE, FIND WHERE LINE
58700 C WOULD COME IN RANGE AND MOVE TO THERE WITH PEN UP
58800 C
58900 IF(XYINCH)1500,1351,1500
59000 1351 IF(OYCH)1352,1354,1352
59100 1352 IF(OXCH)1354,1365,1354
59200 1354 IF(DFLX)1355,1365,1355
59300 C
59400 C INTERPOLATE FROM X OUT OF RANGE, FIND Y WHERE X WOULD COME IN RANGE
59500 C
59600 1355 YPI=DELY/DFLX*(XNFW-X)+Y
59700 IF(YPL) 1365,1385,1360
59800 1360 IF(YPL-YTOP) 1385,1385,1365
59900 1365 IF(DFLY) 1370,1500,1370
60000 C
60100 C INTERPOLATE FROM Y OUT OF RANGE, FIND X WHERE Y WOULD COME IN RANGE
60200 C
60300 1370 XPL=DELX/DELY*(YNFW-Y)+X
60400 IF(XPL) 1500,1380,1375
60500 1375 IF(XPL-XTOP) 1380,1380,1500
60600 1380 YPL=YNFW
60700 GO TO 1400
60800 1385 XPL=XNFW
60900 1400 CONTINUE
61000 CALL DLINE3(XPL,YPI,NLI,NSP,NLO,MSH)
61100 1500 CONTINUE
61200 XYINCH=0
61300 OLDX=X
61400 OLDY=Y
61500 C
61600 C SET FOR NEXT POINT
61700 C
61800 XNFW=X1NFW
61900 YNFW=Y1NFW
62000 X=X1
62100 Y=Y1

```

```

62200      TOUT=2
62300      IF(IFEND-1)1600,1600,1510
62400      GET NEXT POINT
62500      II=II+1
62550      IF(II.GT.NR) GO TO 1140
62575      XA=RANGE(II)
62587      TL=TL.PLOT(II,M)
62593      IF(TL.GT.900.) GO TO 1140
63200      XI=(XA-RMIN)/XSC
63300      YI=(TL-YI)/YSC
63400      1600 CONTINUE
63500      (END LOOP ON THIS CURVE)
63600
63700      GO BACK AND READ NEXT MODEL CARD
63800
63900      GO TO 998
64000      *****
64100      500 CONTINUE
64200
64300      END OF JOB
3500      1000 CALL PLOT(0.,0.,999)
3600      STOP
5400
5500
5600      END
10300      SUBROUTINE DLINE3(X,Y,NLINE,NSPACE,NMORSF,NMORSE1)
10400
10500      THIS SUBROUTINE DRAWS DASHED LINES.
10600
10650      COMMON/SYMPM/M,II
10700      DIMENSION ALEN(2),DELX(2),DELY(2)
10800      ALEN(1)=0.01*NLINE
10900      ALEN(2)=0.01*NSPACE
11000      FACT=4.
11050      DTOR=.017453293
11075      NDECE=1
11100      NMORSF=0
11200      CALL PLOT(X,Y,3)

```

```

11300 XP=X
11400 YP=Y
11500 XOLD=X
11600 YOLD=Y
11700 IFLAG=1
11800 PARTX=1.
11900 RETURN
12000 ENTRY DLINF2
12100 DISTAN=SQRT((X-XOLD)**2 + (Y-YOLD)**2)
12200 IF(DISTAN.LE.0.) RETURN
12300 SINX= (Y-YOLD)/DISTAN
12400 COSX=(X-XOLD)/DISTAN
12500 DELX(1)=ALFN(1)*COSX
12600 DELX(2)=ALFN(2)*COSX
12700 DELY(1)=ALFN(1)*SINX
12800 DELY(2)=ALFN(2)*SINX
12900 IF(FACT.GT.1.) GO TO 15
13000 DELX(1)=FACT*DELX(1)
13100 DELY(1)=FACT*DELY(1)
13200 CONTINUE
13300
13400 DELXP=DELX(IFLAG)*PARTX
13500 DELYP=DELY(IFLAG)*PARTX
13600 IF(ABS(DELXP) .GE. ABS(X-XP) .AND. ABS(DELYP) .GE. ABS(Y-YP))
13700 * GO TO 40
13800 XP=XP+DELXP
13900 YP=YP+DELYP
14000 PARTX=1.
14100 CALL PLOT(XP,YP,IFLAG+1)
14200 IFLAG=3-IFLAG
14300 IF(NMORSE.F0.0) GO TO 20
14400 IF(IFLAG.F0.1) GO TO 20
14500 IMORSE=IMORSE+1
14600 IF(IMORSE.NE. 0 .AND. IMORSE .NE. NMORSE) GO TO 20
14700 FACT=1./FACT
14800 DELX(1)=FACT*DELX(1)
14900 DELY(1)=DELY(1)*FACT
15000 IF(TMORSE.F0.NMORSE ) IMORSE=-NMORSE+1

```

15100		GO TO 20
15200	40	CONTINUE
15300		IF(ARS(DFLX(IFLAG)),.LT.1.F-10) GO TO 45
15400		PARPX=PARTX-ARS((X-XP)/DELY(IFLAG))
15500		GO TO 46
15600	45	CONTINUE
15700		PARTX=PARTX-ARS((Y-YP)/DELY(IFLAG))
15800	46	CONTINUE
15850		IF(VLINE.LT.50)GO TO 48
15862		IF(IT.LT.1)GO TO 48
15868		IF(Y.EQ.0)GO TO 48
15875		MSUR=M
15881		III=II-1
15887		IF(M.GF.R.AND.M.LF.14)MSUR=M-7
15893		IF(M.GF.15.AND.H.LF.21)MSUR=M-14
15896		IF(M.GF.22.AND.M.LF.28)MSUR=M-21
15897		IF(III.LF.R)GO TO 48
15898		IF(MOD(III,R).NE.MSUR)GO TO 48
15899		XP=X-.15*CSX
15900		YP=Y-.15*SINX
15950		CALL PLOT(XP,YP,IFLAG+1)
15975		XP=X-.14*CSX
15987		YP=Y-.14*SINX
15993		FPN=M
15996		ANG=ASIN(SINX)/DTOR
15997		CALL PLOT(XP,YP,3)
15998		CALL NUMBER(XP,YP,.07,FPN,ANG,NDFC)
15999		XP=X
16000		XOLD=X
16025		YP=Y
16050		YOLD=Y
16075		CALL PLOT(XP,YP,3)
16047		GO TO 100
16093	48	XP=X
16096		YP=Y
16100		XOLD=X
16200		YOLD=Y
16300		CALL PLOT(XP,YP,IFLAG+1)
16400	100	CONTINUE
16500		RETURN
16600		END

Section 3 PROGRAM PLTMP

3.1 DESCRIPTION OF PROGRAM

PROGRAM PLTMP provides the ASTRAL user with the diagnostic capability of plotting the mode coupling indices determined by adiabatic mapping for each significant new water depth change.

It is a complete program and is 14336 bytes long. Execution time will vary. The total central processor (CP) time used for the sample run was 2.3 s.

The required input data are listed in table form (Section 3.3). The data fall naturally into two categories: the unformatted, binary data file written by ASTRAL on FILE 4 and the plot-specific information on FILE 5.

Basically PROGRAM PLTMP reads the title, maximum and minimum ranges of interest (nm), scaling factor (nm/inch), and specific track to be processed from FILE 4. It calls subroutine LAYOUT to draw and label the axes. Subroutine BTMPLT is invoked. It reads and stores all required data from FILE 4. The mode coupling indices are plotted by mode. The points are joined in a solid-line and labeled with mode number. After all the data have been processed, control returns to the beginning of the program. The user can plot as many plots as desired.

3.2 MODIFICATIONS TO ASTRAL

Changes have been made in ASTRAL to create the binary, unformatted data file used by PROGRAM PLTMP. File 4

contains the mode coupling indices for each significant new water depth change. Additions have been made to DRIVER, subroutine MARCH, and subroutine COMPDW.

3.2.1 Program DRIVER

A few minor changes have been made in this routine to write the header record and end-of-file on FILE 4. The statements are:

```
DIMENSION TITLE4(20)
DATA TITLE4/4HASTR,4HAL-C,4HOUP,4HING ,4HINDE,
4HX F0,4HR EA,4HCH N,4HEW W,4HATER,4H DEP,4HTH ,
8*4H /
WRITE(4)TITLE4,WHEN
END FILE 4
```

where TITLE4 is obviously the title array and WHEN a variable containing the date of the ASTRAL run.

3.2.2 Subroutine MARCH

Subroutine MARCH controls the flow for the propagation of the field out in range. It calls subroutine COMPDW whenever a significant, new water depth change is introduced. A new parameter has been added to the list of arguments for subroutine COMPDW. The call is

```
CALL COMPDW (FIRST,DEPNW,IXNEW,PHINF(1,IXNEW),
RNG)
```

where RNG is the beginning range for the new water depth.

On the first call to subroutine COMPDW, it treats the receiver, so the beginning range is zero. This value of RNG is defined by the statement

```
RNG=0.0
```

After the loss at the end of the near-field bathymetry has been computed, the environmental index (KENV) is found for the first region. If the new water depth differs significantly from its previous value, COMPDW is called. Here the beginning range (RNG) is the range at the end of the near-field bathymetry. The statement is

```
IF(IR.EQ.2)RNG=RANGE(IR)
```

As subroutine MARCH continues to march out in range, the RNG value for each significant water depth change is set to the beginning range of the environmental index (KENV). The statement is

```
RNG=RENV(KENV)
```

3.2.3 Subroutine COMPDW

Subroutine COMPDW makes the parametric adjustments necessitated by a significant change in water depth. As noted earlier, RNG has been added to its list of arguments. The form of the subroutine is

```
SUBROUTINE COMPDW(FIRST,DEPTH,IX,XPHINF,RNG)
```

Before any calculations are performed, the array MP containing the mode coupling indices is initialized to 999. The array MP(M) will only contain real values between M1 and

M2, the first and last propagating modes. The 999 value will signal PROGRAM PLTMP that all the real data have been processed. Initialization of MP is accomplished by the following statements:

```
DO 30 L=1,25
30    MP(L)=999
```

Each time subroutine COMPDW is called it writes the RNG value and MP array out onto FILE 4. The single statement is

```
WRITE(4)RNG,(MP(M),M=1,25)
```

One file is written on FILE 4 for each track processed by ASTRAL.

3.3 INPUT TO PROGRAM PLTMP

FILE ACCESS NAME FOR005 (FILE 5)

RECORD 1

FORMAT (20A4)

TITLE Title of plot (80 characters).

RECORD 2

FORMAT (3F10.2,I5)

RMAX Maximum range (nm).

RMIN Minimum range (nm).

DELTAR Scaling factor - number of nm/in.

ITRK Number of track to be read on FILE 4 as processed by ASTRAL.

These two records may be repeated for as many plots as desired.

FILE ACCESS NAME FOR004 (FILE 4)
(Unformatted, binary data file generated by ASTRAL)

RECORD 1

TITLE Set to ASTRAL COUPLING INDEX FOR EACH NEW
 WATER DEPTH.

WHEN Date of ASTRAL run (character*9 format).

RECORD 2

RNG Beginning range of each significant new
 water depth change.

MP(M) Mode coupling indices for all 25 modes at
 range, RNG. (A dummy value of 999 is
 supplied for non-propagating modes.)

RECORD 2 is repeated for each significant new water depth
change encountered in the environment.

EOF End-of-file signaling end of data for this
 track.

Entire sequence of records is repeated for each track
processed by ASTRAL. There is one file on FILE 4 for each
track.

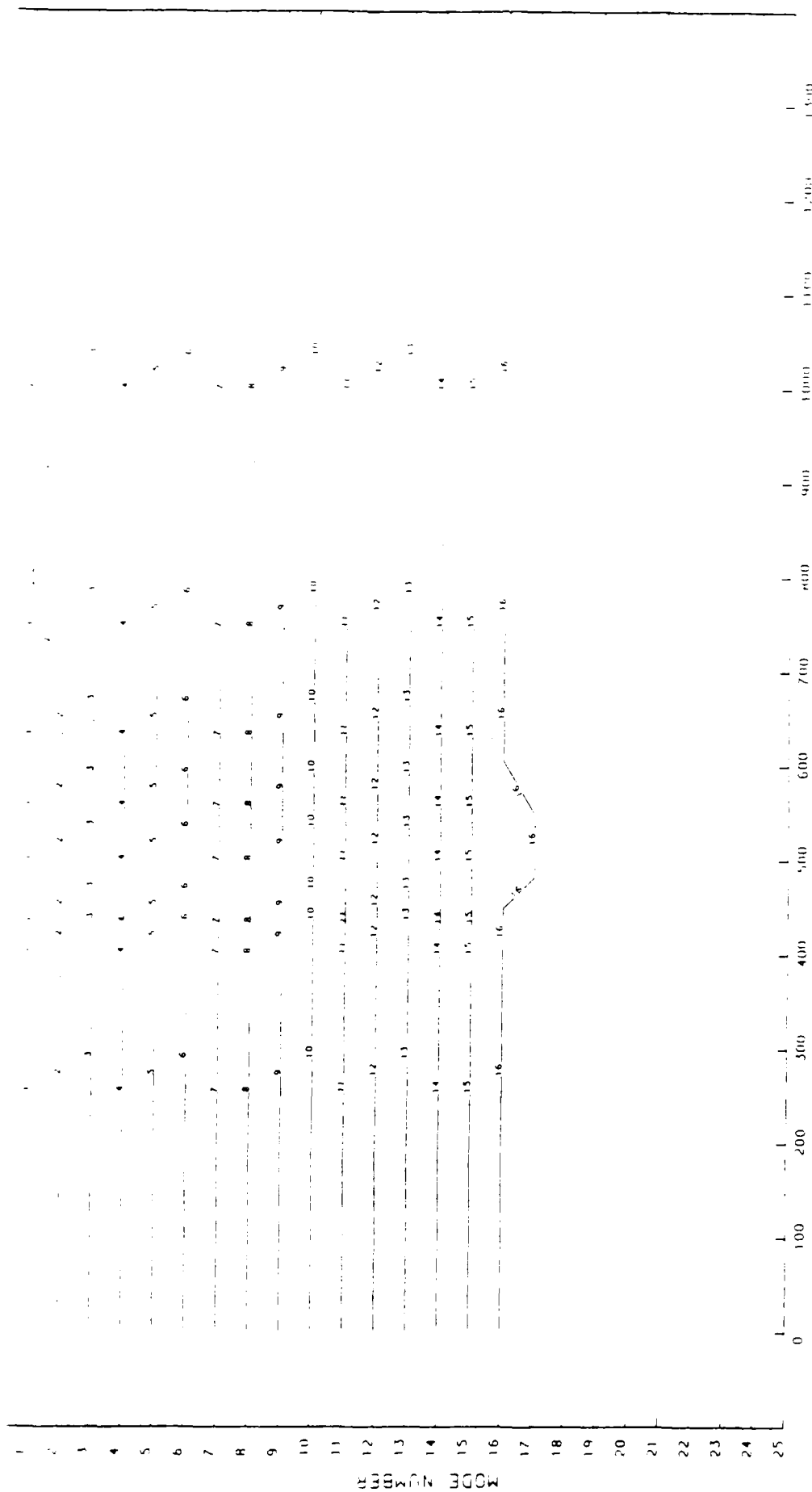
3.4 SAMPLE RUN

INPUT DATA FOR005 (FILE 5)

```
100  SAMPLE RUN FOR PGM PLTMP  
200      1250.      0.      100.      1
```

INPUT DATA FOR004 (FILE 4)

FILE 4 was generated by the ASTRAL propagation loss model using the same input as was used for PROGRAM PLTSMDS (Section 2.4).



RANGE (N.M.)

SAMPLE RUN FOR PCM PLIMP

3.5 SOURCE LANGUAGE LISTING

```

10      PROGRAM PLTMP
20      C
25      PROGRAM READS AND PLOTS MODE COUPLING INDEX AS WRITTEN
27      BY ASTRAL ON FILE 4.
28      C
30      INTEGER TITLE
40      COMMON / PLTR / RASFX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
50      X
60      DIMENSION XNUM(200),TITLE(20),R(201),BD(201),DP(100),SPD(100)
70      C
80      C
90      C
100     C
110     C
120     C
130     C
140     C
150     C
160     C
170     C
180     NIN = 5
190     NOUT = 6
195     ITRK=1
200     NCFL = 4
210     RASEX = 1.5
220     RASEY = 1.3
230     YHT = R.325
240     C
250     OPEN(UNIT=50,TYPE='NEW',NAME='TTA2:X.Y')
255     CALL PLOTS(0,0,50)
260     READ(NIN,100,FID=21)TITLE
270     READ(NIN,110)RMAX,RMIN,DFLTAR,ITRK
280     100 FORMAT(20A4)
290     110 FORMAT(3F10,2,15)
300     C
310     C
          DETERMINE X AXIS AND Y AXIS SCALE FACTORS.

```

```

320 C          CONVERT YMAX TO METERS AND ROUND UPWARDS.
330 C
340 C          NPFN(UNIT=NCPL,TYPE='OLD',FORM='UNFORMATTED')
342 INSK=ITRK-1
344 REWIUD=4
346 IF(INSK.FQ.0)GO TO 15
348 DO 10 I=1,ITRK
350 CONTINUE
352 READ(4,END=10)
354 GO TO 5
356 CONTINUE
358 15 XSCL=1./DELTAR
360 YMAX=25
370 YSCL=YHT/25.
380 NY=25
390 C          DIVIDE THE RANGE INTO INTERVALS. COMPUTE THE
400 C          NUMBER OF INTERVALS AND THE VALUE AT EACH ENDPOINT.
410 C
420 C          NX = (RMAX - RMIN - 1.) / DELTAR + 2.
430 C          RNG = RMIN - DELTAR
440 C          DO 200 I = 1, NX
450 C          RNG = RNG + DELTAR
460 C          K = NX + 1 - I
470 C          XNUM(K) = RNG
480 C          200 CONTINUE
490 C
500 C          RMAX = XNUM(1)
510 C          DRAW THE AXES AND THE BORDER ON THE PLOT.
520 C
530 C          CALL LAYOUT (NY, NCOUNT, NX, TITLE, XNUM, XMAX)
540 C
550 C          DRAW THE SPEED SCALE.
560 C
570 C          SS = XMAX - RMAX * XSCL
580 C
590 C          405 CALL BTMPLT
600 C          AHFAD=XMAX+5.0
610 C          CALL PLOT(AHFAD,0,-3)
620 C          GO TO 20
630 C
640 C
650 C
660 C
670 C
680 C
690 C
700 C
702 C
704 C
706 C

```

```

710 C
720 C
730 C
740 C 21
750 CALL PLOT(0,0,999)
760 CLOSE (UNIT=NCFL)
770 STOP
780 END
790 SURROUTINE RTMPLT
800 C
810 C SURROUTINE RTMPLT READS THE MODE COUPLING INDEX
820 C AND PLOTS THE DATA.
830 C
840 C
850 C
860 C COMMON / PLTR / RASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
870 C X
880 C NIM , NOUT , NCFL , MFAS
890 C DIMENSION SPCE(7)
900 C DIMENSION R(500),HD(500),TITLE(20),MP(500,25)
910 C DATA SPCE/.49,.31,.13,.49,.31,.13,.49/
920 C CHARACTER*9 WHEN
930 C
940 C XSCL AND YLOC ARE INLINE FUNCTIONS THAT SCALE THE
950 C VARIABLES TO BE PLOTTED. NOTE THAT YLOC(0) =
960 C BASEY + YHT, THAT YLOC(YMAX) = RASEY, AND THAT
970 C YLOC(R(1)) = RASEX + 1.
980 C
990 C XLOC(X)=(BASEX + SS + 1.) + X * XSCL
1000 C YLOC(Y)=(BASEY + YHT) - Y * YSCL
1010 C
1020 C NDFC=-1
1030 C
1040 C
1050 C
1060 C 205 I=0
1070 C READ(NCFL,TITLE,WHEN
1080 C I=I+1
1090 C READ(NCFL,END=300)R(I),(MP(I,M),M=1,25)
1100 C GO TO 301
1110 C NRP=I-1
1120 C M=0
1130 C M=M+1
1140 C IF(M.GT.25)GO TO 120
1150 C DO 500 K=1,NRP

```

```

1160      RD(K)=MP(K,M)
1170      IF(RD(1).GT.900.) GO TO 302
1180      PL0T,THE MODE COUPLING INDEX
1200      RDT=AMIN1(40(1),YMAX)
1210      CALL PL0T(XLNC(R(1)),YLNC(RDT),3)
1230      DO 110 Y = 2, NRP
1240      IF(RD(1).GT.900.) GO TO 302
1250      RDT = AMIN1 (RD(1), YMAX)
1350      YPT=YLNC(RDT)
1360      XPT=XLNC(R(1))
1370      FPN=M
1380      DISTAN=SQRT((XPT-XOLD)**2+(YPT-YOLD)**2)
1390      SINX=(YPT-YOLD)/DISTAN
1391      COSX=(XPT-XOLD)/DISTAN
1392      IF(1.E0.2) GO TO 400
1400      IF(SINX.F0.0.0) GO TO 600
1410      XP=XOLD+((XPT-XOLD)/2.0)
1415      XP=XP-.07*COSX
1420      YP=YOLD+((YPT-YOLD)/2.0)
1425      YP=YP-.07*SINX
1430      CALL PL0T(XP,YP,2)
1440      GO TO 601
1450      IF(XPT.LT.5.0) GO TO 400
1460      XDIF=XP-XOLD
1470      IF(XDIFF.LT.0.25) GO TO 400
1490      MSUR=M
1500      IF(M_GF.A.AND.M_LF.14)MSUR=M-7
1510      IF(M_GF.15.AND.M_LF.21)MSUR=M-14
1520      IF(M_GE.22.AND.M_LF.28)MSUR=M-21
1530      SP=SPCF(MSUR)
1540      XP=XPT-SP*COSX
1550      YP=YPT-SP*SINX
1560      CALL PL0T(XP,YP,2)
1570      SP=SP-.01
1580      XP=XPT-SP*COSX
1590      YP=YPT-SP*SINX
1600      ANG=ASIN(SINX)/.017453293
601

```



```

380 YNUM = YNUM - 1.
390 CALL PLOT (RASEX, RASEY + Y, 2)
400 CALL PLOT (RASEX + .1, BASEY + Y, 2)
410 IF (I.EQ.NYPT) GO TO 600
420
430
440
450 CALL NUMBER (RASEX - .3, BASEY + Y, .1, YNUM, 0., -1)
460 CALL PLOT (RASEX, RASEY + Y, 3)
470 CONTINUE
480 RYMAX = BASEY + Y
490 C LABEL Y AXIS.
500 CALL SYMBOL (RASEX - .5, BASEY + 3., .14, 11HMODE NUMBER,
510 C 90., 11)
520 C ALLOW 1" MARGIN ON LEFT OF PLOT.
530 RYMIN = RASEX + 1.
540 CALL PLOT (RASEX, RYMAX, 3)
550 CALL PLOT (RYMIN, RYMAX, 2)
560 CALL PLOT (RYMIN, RYMAX - .1, 2)
570 CALL PLOT (RYMIN, RYMAX, 3)
580 C DRAW X AXIS ON UPPER EDGE OF PLOT. INCLUDE TIC MARKS ONLY,
590 X = 0.
600 NXX = NX - 1
610 DO 300 T = 1, NXX
620 X = X + 1.
630 CALL PLOT (RXMIN + X, RYMAX, 2)
640 CALL PLOT (RXMIN + X, RYMAX - .1, 2)
650 CALL PLOT (RXMIN + X, RYMAX, 3)
660 CONTINUE
670 XMAX = X
680 C ALLOW 1" MARGIN ON RIGHT OF PLOT.
690 RYMAX = RYMIN + X + 1.
700 CALL PLOT (RYMAX, RYMAX, 2)
710 C DRAW Y AXIS ON RIGHT SIDE OF PLOT. INCLUDE TIC
720 MARKS ONLY.
730 DO 400 T = 1, NY
740 Y = Y + YINC
750 CALL PLOT (RYMAX, RASEY + Y, 2)
760 CALL PLOT (RYMAX - .1, BASEY + Y, 2)

```

```

760 CALL PILOT (RXMAX, RASEY + Y, 3)
770 400 CONTINUE
780 C
790 C      DRAW X AXIS ON LOWER EDGE OF PLOT.  INCLUDE TIC
800      MARKS, TITLE, RANGE VALUES, AND MARGINS.
810 CALL PILOT (RXMIN + X, RASEY, 2)
820 DO 520 Y = 1, NX
830 CALL PILOT (RXMIN + X, RASEY, 2)
840 CALL PILOT (RXMIN + X, RASEY + .1, 2)
850 C      DO NOT NUMBER FRACTIONAL PARTS OF MILFS.
860 IF (I.EQ.NX .OR. XNUM(I).EQ.0.) GO TO 500
870 IF (FX(XNUM(I)).EQ.FX(XNUM(I + 1))) GO TO 510
880 500 CONTINUE
890 CALL NUMBER (RXMIN + X - .1, RASEY - .2, .1, XNUM(I), 0., -1)
900 510 CONTINUE
910 CALL PILOT (RXMIN + X, RASEY, 3)
920 X = X - 1.
930 520 CONTINUE
940 CALL PILOT (RASEY, RASEY, 2)
950 C      COMPUTE LABEL OFFSET.  THEN LABEL X AXIS.
960 C
970 IF (NX.LT.21) XOFF=((FLOAT(NX-1)+2)/2.0)-.5
980 CALL SYMBOL (RASEY + XOFF, RASEY - .64, .14, 12HRANGE (H.M.)).
990 C      0., 12)
1000 RETURN
      END

```

Section 4

PROGRAM CFPLT

4.1 DESCRIPTION OF PROGRAM

PROGRAM CFPLT was written to provide the ASTRAL user with the capability of plotting the upper/lower turning point depths for each mode. The program is a modification of PROGRAM CFIELDPLOT which plots sound velocity profiles and, if desired, bathymetry for the given range of interest.

PROGRAM CFPLT is a complete program whose total length is 18944 bytes. Execution time will vary according to the specific input. The central processor time (CP) for the sample run was 3.0 s.

The input of the program varies according to usage. If a plot of the sound velocity profiles is desired, the data is contained on FILE 2 as generated by PEPREP or CFIELD. Bathymetry, if supplied, is read from FILE 5. If a plot of the upper and lower turning point depths for each new environment is requested, the data are obtained from FILE 3 as written by ASTRAL. The bathymetric data are also on FILE 3. The plotting parameters are always specified on FILE 5. A detailed description of the input data is contained in Section 4.3.

Briefly, PROGRAM CFPLT reads the title, maximum and minimum ranges of interest (nm), scaling factor (nm/inch), maximum depth of plot (ft), and the variable IPROF specifying the type of plot. Subroutine LAYOUT is called to draw and label the axes. At this point the program follows two separate paths.

If IPROF equals zero, a plot of sound velocity profiles is desired. The program calls subroutine SPDSCL to draw the sound speed scale. The actual depth/velocity pairs for each range are read by subroutine SVPRD and plotted by subroutine SVPPLT. These two programs are called sequentially until all the profiles in the given range of interest have been processed. Subroutine BTMRD accesses FILE 5 for the bathymetric data. If supplied, subroutine BTMPLT plots the data in the specified manner (point by point or as a step function). The program always returns to the beginning to enable the user to generate as many plots as desired.

If IPROF equals one, a plot of the upper/lower turning point depths overlaid on the bathymetry of the area is desired. The program calls subroutine BTMPLT. This subroutine fetches and stores all the pertinent ASTRAL information from FILE 3. A separate curve is drawn for each mode of both the upper and lower turning point depths. The points are connected with a solid line and labeled with mode number. The bathymetry is plotted as a step function which is the way it is actually treated in the ASTRAL model. Plot finished, PROGRAM CFPLT returns to the beginning to accept a new set of input data.

4.2 MODIFICATIONS TO ASTRAL

PROGRAM CFPLT requires a binary, unformatted data file containing bathymetry and upper/lower turning point depths. All of this information is readily available in the main program driver (DRIVER) and needs only to be written out onto FILE 3.

4.2.1 Program DRIVER

The changes made in DRIVER are as follows:

Dimension title array (TITLE3) and SRENV array used to store the beginning range for each new environment.

```
DIMENSION TITLE3(20), SRENV(20)
```

Define actual title with data statement.

```
DATA/TITLE3/4HASTR,4HAL-U,4HPPER,4H/LOW,4HER T,4HURNI,  
4HNG P,4HOINT, 4H DEP, 4HTHS , 10*4H    /
```

Locate the beginning range for each new environment and store in array SRENV. The variable JTOP is set to the number of environments. The arrays used in this exercise are found in labeled common /ENVDET/. The statements are

```
      J = 1  
      IRTFE =1  
      DO 51 L = 1, NENV  
        IF (INDEX(L).NE.J) GO TO 51  
        SRENV(J) = RENV(L)  
        J = J+1  
51    CONTINUE  
      JTOP = J-1
```

Write the header record containing the title (TITLE3) and date of ASTRAL run (WHEN).

```
WRITE(3) TITLE3, WHEN
```

Write all the bathymetric data onto FILE 3. The range/depth pairs for the detailed ray trace front end are contained in arrays BRANGE and DEPTH found in labeled common /BOTTOM/. The remainder of the range/depth pairs are found in arrays RENV and DEP.

```
DO 300 J = 1, NBP
```

```

300      WRITE(3) BRANGE(J), DEPTH(J)
        DO 301 J = 2, NENV
          IF (RENV(J).LE.BRANGE(NBP)) GO TO 301
          WRITE(3) RENV(J), DEP(J)
301      CONTINUE

```

Write end-of-file to signal end of bathymetric data.

END FILE 3

Write out the previously determined beginning ranges for each new environment.

```

WRITE(3) JTOP, (SRENV(J), J= 1, JTOP)

```

Write out the receiver depth (ZR) and its immediate slope (THBRC), range at end of near-field bathymetry (RNFBBDT) and variable (IRTFE) signaling ray trace front end version of ASTRAL. This information is all stored in labeled commons /RECVER/ and /DETRAY/.

```

WRITE(3) ZR, THBRC, RNFBBDT, IRTFE

```

Finally write out the upper/lower turning point depths for all twenty-five modes at JTOP environments. Terminate the file for this track with an end-of-file mark.

```

DO 209 M = 1, 25
  WRITE(3) (ZUP(M,J), J = 1, JTOP)
  WRITE(3) (ZDN(M,J), J = 1, JTOP)
209  CONTINUE
    END FILE 3

```

All of these changes have been inserted inside the track loop of DRIVER. This means that two files of data will be written on FILE 3 for each track processed by ASTRAL.

4.3 INPUT TO PROGRAM CFPLT

FILE ACCESS NAME FOR005 (FILE 5)

RECORD 1

FORMAT (20A4)

TITLE Title - 20 words (80 characters).

RECORD 2

FORMAT (4F10.2, 2I5)

RMAX Maximum range (nm).

RMIN Minimum range (nm).

DELTAR Scaling factor - numbers of nm/inch.

YMAX Maximum depth (ft) of plot.
(Maximum depth plotted on meter scale; therefore, maximum depth should be less than even hundred meters wanted.)

I PROF Variable to determine type of plot.

=0 Plot SS profiles-data FILE 2
Read bathymetric data - FILE 5
Plot bathymetry - point by point or as step function

=1 Plot upper/lower turning point depths - data FILE 3
Read bathymetry - FILE 3
Plot bathymetry as step function

ITRK Number of track as processed by ASTRAL to be
read on FILE 3.

RECORD 3 FORMAT(2I5)

NBP Number of (range, depth' pairs of bathymetry
to be read in.
if >0, input in (nm,ft)
if <0, input in (nm, meters)

ISTEP Type of bathymetric plot.
= 0 Plot point by point
= 1 Plot as step function

RECORD 3 IS OMITTED IF

1. No bathymetry to be plotted with sound
velocity profiles.
2. IPROP = 1 (Bathymetry read FILE 3).

RECORD 4 FORMAT (8F10.2)

R Range (nm).

BD Depth (ft or meters) as specified on
RECORD 3.

Four range/depth pairs contained on each record. RECORD 4
repeated as many times as required to read in NBP pairs of
bathymetric points

RECORD 4 IS OMITTED IF RECORD 3 IS OMITTED.

Sequence of records may be repeated for as many plots as
desired.

FILE ACCESS NAME FOR003 (FILE 3)
(Unformatted, binary data file written by ASTRAL)

RECORD 1

TITLE3 Set to ASTRAL UPPER/LOWER TURNING POINT
 DEPTHS.

WHEN Date of ASTRAL run (character*9 format).

RECORD 2

RANGE Range (nm).

DEPTH Depth (ft).

One range/depth pair written on each record. RECORD 2
repeated till all bathymetric data is written out.

EOF End-of-file.

RECORD 1

JTOP Number of elements in SRENV array.

SRENV Array containing beginning range of each new
 environment.

RECORD 2

ZR Receiver depth (ft).

THBRC Immediate slope of receiver (radians) -
 negative down.

RNFBDT Range of near-field bathymetry (nm).

IRTFE Variable signifies version of ASTRAL which
generated FILE 3.

 =0 Regular version
 CFPLT plots ZR and THBRC.

 =1 Ray trace front end version ZR and THBRC not
 plotted.

RECORD 3

(ZUP(M,J),J=1,JTOP) Array containing upper turning point
 depths at JTOP environments for mode M.

(ZDN(M,J),J=1,JTOP) Array containing lower turning point
 depths at JTOP environments for mode M.

RECORDS 3 and 4 repeated sequentially 25 times - once for
each mode.

EOF End-of-file.

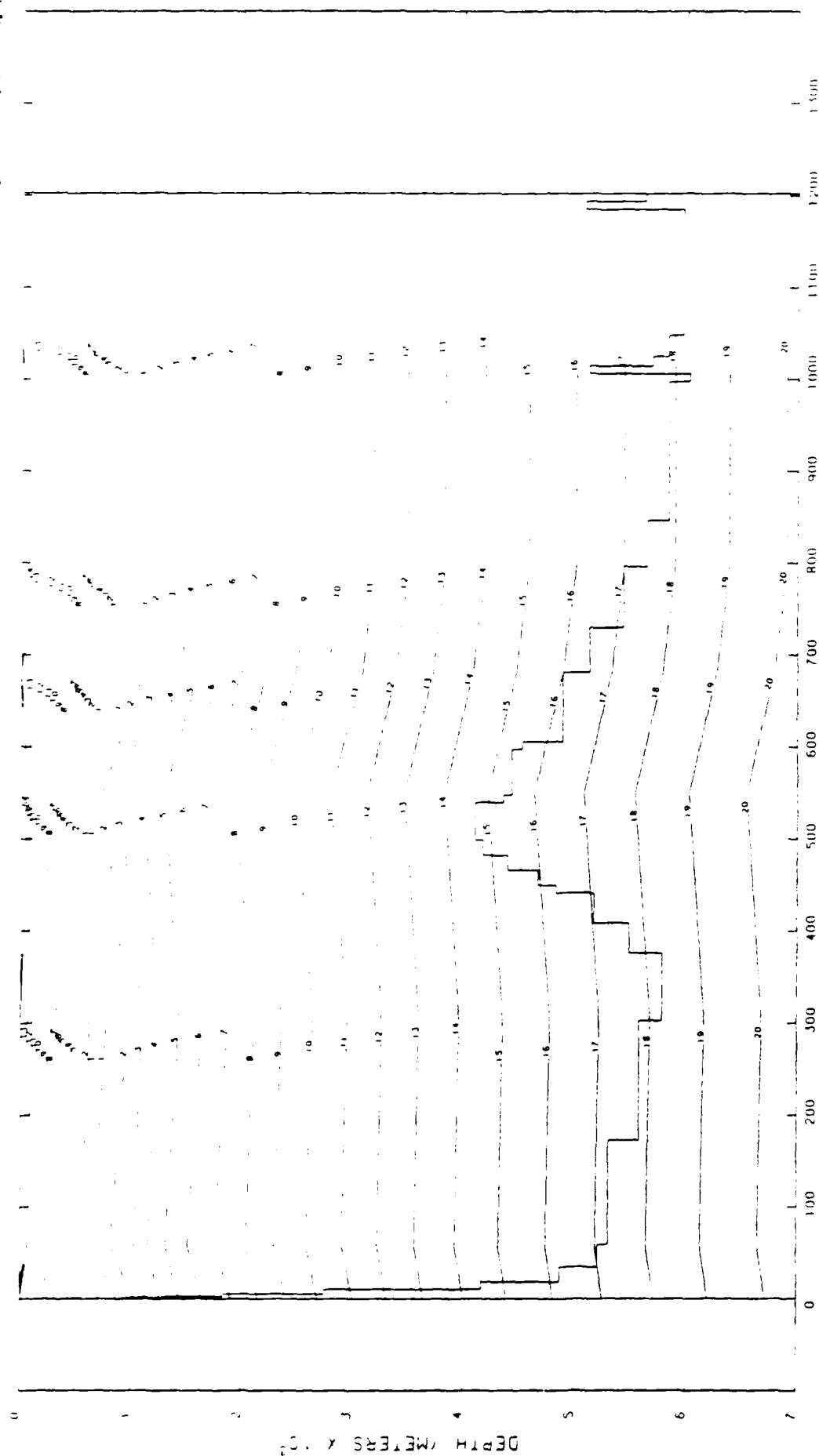
4.4 SAMPLE RUN

INPUT DATA FOR005 (FILE 5)

```
100  SAMPLE RUN FOR PGM CFPLT
200      1250.          0.      100.      20000.      1      1
```

INPUT DATA FOR003 (FILE 3)

FILE 3 was generated by the ASTRAL propagation loss
model using the same input as was used for PROGRAM PLTSMDS
(Section 2.4).



SAMPLE RUN FOR PCM CEPLT

4.5 SOURCE LANGUAGE LISTING

```

100      PROGRAM CFPLT
200      C
300      C      CFPLT GENERATES A PLOT OF THE SOUND SPEED PROFILES AND
400      C      BATHYMETRY FOR A GIVEN RANGE OF INTEREST. THE DESIRED RANGE,
500      C      PROFILES ARE INPUT FROM A TAPE2 GENERATED BY PEPREP AND CFIELD.
600      C
700      C      CFPLT AS MODIFIED WILL ALSO PLOT UPPER AND LOWER TURNING
800      C      POINTS AND BATHYMETRY FOR A GIVEN RANGE OF INTEREST. THE
900      C      DATA IS ALL READ FROM A TAPE3 GENERATED BY ASTRAL.
1000     C
1100     C      INTEGER TITLE
1200     C      COMMON / PLTR / RASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
1300     C      X          NIN , NOUT , NCFL , MFAS
1400     C      DIMENSION XNUM(200),TITLE(40),R(500),RD(500),DP(100),SPD(100)
1500     C
1600     C      RASEX AND BASEY ARE THE MARGINS (IN INCHES) ON
1700     C      THE SIDES OF THE PLOTS. YHT IS THE WIDTH OF THE
1800     C      PLOT.
1900     C
2000     C      READ TITLE, MAXIMUM AND MINIMUM RANGES OF INTEREST
2100     C      (N.M.), SCALING FACTOR (N.M./IN.), MAXIMUM DEPTH
2200     C      (FT.),TYPE OF PLOT (SS PROFILE OR ZUP/ZDN)
2300     C
2400     C      IPRNF=0  PLOT SS PROFILE, READ BATHY FROM CARDS.
2500     C      PLOT BATHY POINT-WISE OR STEP-WISE.
2600     C
2700     C      IPRNF=1  PLOT ZUP/ZDN, READ BATHY FROM SAME TAPE,
2800     C      PLOT BATHY STEP-WISE.
2900     C
3000     C      NIN = 5
3100     C      NOUT = 6
3200     C      NCFL = 2
3300     C      ITRK=1
3400     C      RASEX = 1.5
3500     C      BASEY = 1.3
3600     C      YHT = 8.4

```

```

3700 OPEN(UNIT=50,TYPE='NEW',NAME='TTA2:X,Y')
3750 CALL PLOTS(0,0,50)
3800 READ(NIN,100,END=21)TITLE
3900 READ(NIN,110)RMAX,RMIN,DELTAR,YMAX,IPOFF,ITRK
4000 FORMAT(40A2)
4100 110 FORMAT(4F10.2, 2I5)
4200 C
4300 C DETERMINE X AXIS AND Y AXIS SCALE FACTORS.
4400 C CONVERT YMAX TO METERS AND ROUND UPWARDS.
4500 C
4600 C
4700 IF(IPOFF.EQ.1)NCFL=3
4750 OPEN(UNIT=NCFL,TYPE='OLD',FORM='UNFORMATTED')
4752 C TWO FILDS WRITTEN FOR EVERY TRACK
4754 INSK=(ITRK*2)-2
4756 REWIND NCFL,
4758 IF(INSK.EQ.0)GO TO 15
4760 DO 10 I=1,INSK
4762 5 CONTINUE
4764 READ(INSK,FND=10)
4766 GO TO 5
4768 10 CONTINUE
4800 15 XSCL = 1. / DELTAR
4900 YMAX = .3048 * YMAX
5000 NCOUNT = ALOG10(YMAX)
5100 COUNT = 10. ** NCOUNT
5200 NY = 1 + INT(YMAX / COUNT)
5300 YMAX = COUNT * FLOAT(NY)
5400 YSCL = YHT / YMAX
5500 YMFT = YMAX / .3048
5600 C
5700 C
5800 C
5900 C
6000 C
6100 C
6200 C
6300 C
6400 NX = (RMAX - RMIN - 1.) / DELTAR + 2.
6500 RNG = RMIN - DELTAR
6600 DO 200 I = 1, NX

```

DIVIDE THE RANGE INTO INTERVALS. COMPUTE THE
NUMBER OF INTERVALS AND THE VALUE AT EACH ENDPOINT.

```

6700      RNG = RNG + DELTAR
6800      K = NX + 1 - I
6900      XNUM(K) = RNG
7000      200 CONTINUE
7100      RMAX = XNUM(1)
7200
7300
7400
7500      WRITE(NOUT,210) TITLE,RMIN,RMAX,DELTAR,YMAX,YMFT
7600      210 FORMAT(1H1.40A2,/,7HORANGE ,F7.2,8H N.M. TO ,F9.2,5H N.M. ,/,
7700      C      14H SCALE FACTOR- , F7.2, 9H N.M./IN. /
7800      C      15H MAXIMUM DEPTH-, F9.2, 4H M (, F9.2, 5H FT.))
7900
8000
8100
8200      CALL LAYOUT (NY, NCOUNT, NX, TITLE, XNUM, XMAX)
8300
8400      DRAW THE SPEED SCALE.
8500
8600      SS = XMAX - RMAX * XSCL,
8700      IF(IPROF.EQ.1)GO TO 500
8800      CALL SPDSCL(NX)
8900
9000      READ THE SOUND SPEED PROFILES.
9100
9200      WRITE(NOUT,300)
9300      300 FORMAT(24H0SOUND SPEED PROFILES
9400      REWIND NCFL,
9500
9600
9700      IT MAY BE NECESSARY TO DELETE THE FOLLOWING CARD
9800      IF TAPE2 WAS GENERATED BY A PROGRAM OTHER THAN
9900      PEPRP.
10000
10100      READ(NCFL, )
10200      310 CONTINUE
10300      CALL SVPRD (RMAX,RMIN,RNG,N,DP,SPD)
10400
10500      IF IN RANGE, PLOT THE PROFILES.

```

```

10600 IF (RNG.IT.RMIN) GO TO 310
10700 IF (RNG.OT.RMAX) GO TO 400
10800 CALL SVPLT (RNG.N.OP,SPD)
10900 GO TO 310
11000 C
11100 C READ AND PLOT THE HATHYMETRY FROM CARDS
11200 C
11300 400 CONTINUE
11400 CALL ATMRD(RMAX,RMTN,NRP,R.RD,ISTEP)
11500 C IF NRP=0, ONLY PLOT SS PROFILES - NO RATHY GIVEN.
11600 IF(NRP.EQ.0)GO TO 410
11700 500 CALL ATMPLT (NRP, R, RD,ISTEP,IPROF)
11800 410 CONTINUE
11900 AHFAD=X*AX+9.0
12000 CALL PLOT(AHFAD,0,-3)
12100 GO TO 20
12200 C
12300 C CLOSE PLOT OUTPUT FILE.
12400 C
12500 21 CALL PLOT(0,0,999)
12600 CLOSE (UNIT=MCFL)
12700 STOP
12800 END
12900 C
13000 C SUBROUTINE ATMPLT (NRP, RR, RD,ISTEP,IPROF)
13100 C
13200 C SUBROUTINE ATMPLT DRAWS MARGINS ON THE PLOT AND
13300 C PLOTS THE HATHYMETRY, IF GIVEN. THE BOTTOM PROFILE
13400 C POINTS ARE CONNECTED BY STRAIGHT LINES. HOWEVER,
13500 C ONLY THAT PORTION OF THE BOTTOM PROFILE ABOVE
13600 C THE MAXIMUM DEPTH OF INTEREST IS SHOWN.
13700 C
13800 C COMMON / PLTR / RASEX , RASEY , XSCL , YSCL , YHT , YMAX , SS ,
13900 C MIN , NOUT , NCFL , MFAS
14000 C
14100 C DIMENSION PR(500), ARD(500)
14200 C DIMENSION SPCE(7)
14300 C DIMENSION IFLAG(20)
14400 C DIMENSION R(500),RD(500)
14500 C DIMENSION SPENV(20),ZUP(50,20)
14600 C DIMENSION TITLE3(20)
14700 C DATA SPCE/.45,.40,.35,.30,.25,.20,.15/

```

```

14500 CHARACTER*9 WHEN
14600 C      XLDC AND YLOC ARE INLINE FUNCTIONS THAT SCALE THE
14700 C      VARIABLES TO BE PLOTTED.  NOTE THAT YLOC(0) =
14800 C      BASEY + YHT, THAT YLOC(YMAX) = BASEY, AND THAT
14900 C      YLOC(P(1)) = BASEX + 3.
15000 XLDC(X)=(BASEX + SS + 1.) + X * XSCL
15100 YLOC(Y)=(BASEY + YHT) - Y * YSCL
15200 NDFC=-1
15300 IF(IPKOF.F0.0)GO TO 205
15350 ISTEP=1
15400 READ(3)TITLE3,WHEN
15500 C      READ RATHY FROM TAPE3 AS WRITTEN BY ASTRAL.
15600 DO 701 J=1,500
15700 READ(3,END=700)RR(J),RRD(J)
15800 701 CONTINUE
15900 C      READ ZUP/ZDN VALUES FROM TAPE3 GENERATED BY ASTRAL.
16000 DO 700 NNRP=J-1
16050 700 NNRP=J-1
16062 C      CONVERT FEET TO METERS
16075 DO 99 J=1,NNRP
16087 RRD(J)=RRD(J)*.3048
16100 READ(3) JTOP,(SRFV(J),J=1,JTOP)
16200 READ(3)ZP,THARC,RNFR,IRTFE
16300 ZR=ZR*.3048
16400 C
16500 DO 300 M=1,25
16600 READ(3,END=205)(ZUP(M,J),J=1,JTOP)
16700 READ(3,END=205)(ZUP(M+25,J),J=1,JTOP)
16800 300 CONTINUE
16900 C      INITIALIZE THE PLOT BY DRAWING THE MARGIN AT MINIMUM RANGE.
17000 205 CALL PLOT (BASEX + 3., BASEY + YHT, 3)
17100 CALL PLOT (BASEX + 3., BASEY, 2)
17200 C
17300 M=0
17400 IF(ISTEP.F0.0)GO TO 600
17500 C      CALCULATE EXTRA POINT TO PLOT RATHY STEP-WISE.
17600 P(1)=RR(1)
17700 RDC(1)=RRD(1)
17800 J=0
17900 DO 500 L=2,NNRP
18000 J=J+2
18100

```



```

18200 R(J)=RR(I.)
18300 RD(J)=RRD(L-1)
18400 R(J+1)=RR(L)
18500 RD(J+1)=RRD(L)
18600 CONTINUE
18700 NRP=J+1
18800 GO TO 200
18900 DO 601 L=1,NRP
19000 R(L)=RR(I.)
19100 RD(L)=RRD(L)
19200 NRP=NRP
19300 C
19400 C
19500 RDT=AMIN1(RD(1),YMAX)
19600 CALL PLOT(RASEX+1.,YLOC(RDT),3)
19700 C
19800 DO 110 Y = 2, NRP
19900 RDT = AMIN1 (RD(I), YMAX)
20000 C
20100 C DOES THE LINE TO THE NEXT POINT CROSS YMAX?
20200 IF ((RD(I - 1) - YMAX) * (RD(I) - YMAX)) .GE. 0.) GO TO 100
20300 C THERE IS A CROSSING AT XMAX. DRAW A LINE TO THERE.
20400 XMAX = R(I - 1) + (YMAX - RD(I - 1)) * (R(I) - R(I - 1)) /
20500 C (RD(I) - RD(I - 1))
20600 C DRAW A LINE TO THE NEXT PROFILE POINT (OR TO
20700 C YMAX IF THAT POINT IS DEEPER THAN YMAX).
20800 CALL PLOT (XLOC(XMAX), BASEY, 2)
20900 CONTINUE
21000 YPT=YLOC(RDT)
21100 XPT=XLOC(R(I))
21200 IF(YPT.LE.(BASEY+.005))GO TO 400
21300 IF(M.EQ.0)GO TO 400
21400 IF(RDT.EQ.0)GO TO 400
21500 IF(I.EQ.2)GO TO 400
21600 DISTAN=SQRT((XPT-XOLD)**2+(YPT-YOLD)**2)
21700 SINX=(YPT-YOLD)/DISTAN
21800 COSX=(XPT-XOLD)/DISTAN
21900 MM=M
22000 IF(MM.GT.25)MM=MM-25

```

THE RATHMETRY HAS BEEN GIVEN. MOVE THE PEN TO THE STARTING POINT.

LOOP OVER EACH BOTTOM PROFILE POINT.

DOES THE LINE TO THE NEXT POINT CROSS YMAX?

THERE IS A CROSSING AT XMAX. DRAW A LINE TO THERE.

DRAW A LINE TO THE NEXT PROFILE POINT (OR TO YMAX IF THAT POINT IS DEEPER THAN YMAX).

```

22000 FPN=MH
22100 MSUR=MM
22200 IF(MM.GE.8.AND.MM.LE.14)MSUR=MM-7
22300 IF(MM.GE.15.AND.MM.LE.21)MSUR=MM-14
22400 IF(MM.GE.22.AND.MM.LE.28)MSUR=MM-21
22500 SP=SPCF(MSUR)
22600 XP=XPT-SP*COSX
22700 YP=YPT-SP*SINX
22800 CALL PLOT(XP,YP,2)
22900 SP=SP-.01
23000 XP=XPT-SP*COSX
      YP=YPT-SP*SINX
23100 ANG=ASIN(SINX)/.017453293
23200 CALL NUMRER(XP,YP,.07,FPN,ANG,NDFC)
23300
23400 400 XP=XPT
23500 YP=YPT
23600 XOLD=XPT
23700 YOLD=YPT
23800 CALL PLOT(XP,YP,2)
23900 110 CONTINUE
24000 IF(IPROF.EQ.0)GO TO 121
24100 IF(M.NF.0)GO TO 120
24200 IF(IRTFE.EQ.1)GO TO 207
24250 C PLOT RECEIVER DEPTH AND IMMEDIATE SLOPE IF REG. ASTRAL.
24300 CALL PLOT(XLOC(0),YLOC(ZR),3)
24400 CALL PLOT(XLOC(RNFR),YLOC(ZR),2)
24500 CALL PLOT(XLOC(0),YLOC(ZR),3)
24600 Y1=2P-RNFR*6076.1*.3048*TAN(THARC)
24700 CALL PLOT(XLOC(RNFR),YLOC(Y1),2)
24750 C FINISH THE PLOT BY DRAWING A MARGIN.
24800 207 CALL PLOT(XLOC(R(NRP)),BASEY,3)
24900 CALL PLOT(XLOC(R(NRP)),BASEY+YHT,2)
25000 120 CONTINUE
25100 M=M+1
25200 IF(M.GT.50)RETURN
25300 DO 201 I=1,JTOP
25400 IF(AG(I)=0
25500 22=ZUP(M,I)
25600 RD(I)=77*.3048
25700 R(I)=SPENV(I)
25800
25900

```

```

26000 201 CONTINUE
26100 NRP=JTOP
26150 DO 705 I=1,JTOP
26175 IF(HD(I).GT.0.0.AND.RD(I).LT.YMAX)GO TO 200
26187 CONTINUE
26193 GO TO 120
26400 705 CALL PLOT(XLOC(R(NRP)),RASEY,3)
26500 121 CALL PLOT (XLOC(R(NRP)), RASEY + YHT, 2)
26600 RETURN
26800 END
26900 SURROUTINE RTMRD (RMAX, RMIN, NRP, R, RD,ISTEP)
27000 COMMON / PLTR / RASEX , RASEY , XSCL , YSCL , YHT , YMAX , SS ,
27100 X NIN , NOUT , NCFL , MFAS
27200 C
27300 C SURROUTINE RTMRD READS THE BATHYMETRY FROM
27400 C CARDS. THE MINIMUM RANGE AT WHICH A BOTTOM IS
27500 C SPECIFIED CANNOT BE GREATER THAN RMIN. IF
27600 C NECESSARY THE BOTTOM AT RMIN IS CALCULATED BY
27700 C INTERPOLATION. IF THE BOTTOM AT RMAX IS NOT
27800 C GIVEN, THEN IT IS CALCULATED BY INTERPOLATION OR
27900 C BY EXTENDING THE BOTTOM OF THE MAXIMUM RANGE
28000 C POINT KNOWN. THE PROGRAM CONVERTS THE FINAL
28100 C PROFILE TO METERS IF NECESSARY AND OUTPUTS THE
28200 C RESULTS.
28300 C
28400 C DIMENSION R(500), RD(500)
28500 NRP = 0
28600 MSW = 0
28700 C READ THE NUMBER OF BOTTOM POINTS. RETURN IF NONE
28750 C READ ISTEP = 0 PLOT BATHY POINT-WISE
28775 C 1 PLOT BATHY STEP-WISE
28787 C
28800 READ(NIN,100,END= 105) NRP,ISTEP
28900 100 FORMAT(2I5)
29000 GO TO 107
29100 105 NRP = 0
29200 RETURN
29300 C
29400 C IF THE GIVEN NUMBR IS NEGATIVE, THE DEPTHS ARE
29500 C GIVEN IN METERS, NOT FEET.
29600 107 IF (NRP.LT.0) MSW = 1
29700 NRP = IARS(NRP)
29800 C READ THE POINTS.

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29900 READ(NIN,110) (R(I),BD(I),I=1,NRP)
30000 110 FORMAT (RF10.2)
30100 C DOES THE RATHYMETRY INCLUDE THE RANGE OF INTEREST?
30200 150 CONTINUE
30300 IF (P(NRP).GE.RMIN) GO TO 200
30400 R(1) = RMIN
30500 RD(1) = RD(NRP)
30600 R(2) = RMAX
30700 BD(2) = BD(NRP)
30800 NRP = 2
30900 RETURN
31000 C IS THE FIRST POINT AT RMIN?
31100 200 CONTINUE
31200 K = 0
31300 IF (R(1) - RMIN) 230, 300, 210
31400 210 CONTINUE
31500 C THE RATHYMETRY IS NOT SPECIFIED FOR RMIN AND SO IS DELETED
31600 WRITE(NOUT,220)
31700 220 FORMAT (47HORATHYMETRY DELETED. VALUE REQUIRED FOR MINIMUM,
31800 C 7H RANGE.)
31900 NRP = 0
32000 RETURN
32100 230 CONTINUE
32200 C THE K-TH POINT IN THE RATHYMETRY PRECEDES RMIN.
32300 K = K + 1
32400 IF (R(K + 1) - RMIN) 230, 250, 240
32500 240 CONTINUE
32600 C THE (K+1)ST POINT FOLLOWS RMIN. INTERPOLATE
32700 C TO OBTAIN BOTTOM AT RMIN.
32800 RD(K) = RD(K) + (RMIN - R(K)) * (RD(K + 1) - BD(K)) /
32900 C (R(K + 1) - R(K))
33000 R(K) = RMIN
33100 K = K - 1
33200 IF (K.FD.0) GO TO 300
33300 250 CONTINUE
33400 NRP = NRP - K
33500 DO 260 I = 1, NRP
33600 LUL=K+I

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33700 R(I)=R(LLL)
33800 RD(I)=RD(LLL)
33900 C
34000 THE FIRST POINT IS NOW AT RMIN.
34100 C
34200 300 CONTINUE
34300 C
34400 IS THE LAST POINT AT RMAX?
34500 IF (R(NRP) - RMAX) 310, 340, 320
34600 310 CONTINUE
34700 C
34800 THE LAST POINT PRECEDES RMAX. COMPLETE ASSUMING A FLAT BOTTOM
      NRP = NRP + 1
      R(NRP) = RMAX
      RD(NRP) = RD(NRP - 1)
      GO TO 340
34900 C
35000 320 CONTINUE
35100 C
35200 NRP = NRP - 1
35300 IF (R(NRP) - RMAX) 330, 340, 320
35400 330 CONTINUE
35500 C
35600 RMAX IS IN THIS INTERVAL. INTERPOLATE TO FIND BOTTOM THERE
35700 NRP = NRP + 1
35800 RD(NRP) = RD(NRP - 1) + (RMAX - R(NRP - 1)) * (RD(NRP) -
35900 C      RD(NRP - 1)) / (R(NRP) - R(NRP - 1))
36000 R(NRP) = RMAX
36100 C
36200 THE LAST BOTTOM POINT IS NOW AT RMAX.
36300 C
36400 ARE THE DEPTHS IN METERS?
36500 IF (MSW.FO.0) GO TO 410
36600 C
36700 YES, WRITE THEM OUT.
36800 WRITE(NOUT,400) (P(I),RD(I),I=1,NRP)
36900 C
37000 400 FORMAT (11HORATHYMETRY / 27H RANGE (M.M.)    DEPTH (M) /
37100 C      (F10.2, 9X, F7.2))
37200 RETURN
37300 C
37400 410 CONTINUE
37500 C
37600 NO, CONVERT THEM AND WRITE THEM OUT.
      WRITE(NOUT,420)
37700 C
37800 420 FORMAT (11HORATHYMETRY / 13H RANGE (M.M.), 5X, 11HDEPTH (FT.))
37900 C
38000 ON 440 I = 1, NRP
38100 D = RD(I)
38200 RD(I) = .3048 * D

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3500 RYMAX = RASEY + Y
3600 LABEL Y AXIS.
3700 CALL SYMBOL (RASEX - .5, RASEY + 3., .14, 20DEPTH (METERS X 10 ),
3800 90., 20)
3900 NCOUNT = ICHARS(NCOUNT+1)
4000 CALL SYMBOL (RASEX - .6, RASEY + 5.5, .1, NCOUNT, 90., 1)
4100 ALLOW 1" MARGIN ON LEFT OF PLOT.
4200 RXMIN = RASEX + 1.
4300 CALL PLOT (RASEX, RYMAX, 3)
4400 CALL PLOT (RXMIN, RYMAX, 2)
4500 CALL PLOT (RXMIN, RYMAX - .1, 2)
4600 CALL PLOT (RXMIN, RYMAX, 3)
4700 DRAW X AXIS ON UPPER EDGE OF PLOT. INCLUDE TIC MARKS ONLY
4800 X = 0.
4900 NXX = NX - 1
5000 DO 300 I = 1, NXX
5100 X = X + 1.
5200 CALL PLOT (BXMIN + X, RYMAX, 2)
5300 CALL PLOT (RXMIN + X, RYMAX - .1, 2)
5400 CALL PLOT (BXMIN + X, RYMAX, 3)
5500 300 CONTINUE
5600 XMAX = X
5700 ALLOW 1" MARGIN ON RIGHT OF PLOT.
5800 RXMAX = RXMIN + X + 1.
5900 CALL PLOT (RXMAX, RYMAX, 2)
6000 DRAW Y AXIS ON RIGHT SIDE OF PLOT. INCLUDE TIC
6100 MARKS ONLY.
6200 DO 400 I = 1, NY
6300 Y = Y + YINC
6400 CALL PLOT (RXMAX, RASEY + Y, 2)
6500 CALL PLOT (RXMAX - .1, RASEY + Y, 2)
6600 CALL PLOT (RXMAX, RASEY + Y, 3)
6700 400 CONTINUE
6800 DRAW X AXIS ON LOWER EDGE OF PLOT. INCLUDE TIC
6900 MARKS, TITLE, RANGE VALUES, AND MARGINS.
7000 CALL PLOT (RXMIN + X, RASEY, 2)
7100 DO 520 I = 1, NX
7200 CALL PLOT (RXMIN + X, RASEY, 2)
7300 CALL PLOT (RXMIN + X, RASEY + .1, 2)
7400 DO NOT NUMBER FRACTIONAL PARTS OF MILES.

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7500 IF (J.EQ.NX .OR. XNUM(I).EQ.0.) GO TO 500
7600 IF (FX(XNUM(I)).EQ.FX(XNUM(I + 1))) GO TO 510
7700 500 CONTINUE
7800 CALL NUMBER (BXMIN + X - .1, BASEY - .2, .1, XNUM(I), 0., -1)
7900 510 CONTINUE
8000 CALL PLOT (BXMIN + X, BASEY, 3)
8100 X = X - 1.
8200 520 CONTINUE
8300 CALL PLOT (BASEX, BASEY, 2)
8400 C COMPUTE LABEL OFFSET. THEN LABEL X AXIS.
8500 C
8600 IF (NX.LT.21) XOFF = ((FLOAT(NX-1)+2)/2.0)-.5
8700 CALL SYMBOL (BASEX + XOFF, BASEY - .64, .14, 12HRANGE (N.M.))
8800 C 0., 12)
8900 RETURN
9000 END

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100 SURROUTINE SPDSCL(NX)
200 COMMON / PLTR / BASEX, BASEY, XSCL, YSCL, YHT, YMAX, SS,
300 X WIN, NOUT, NCFL, HFAS
400 C SPDSCL DRAWS THE SOUND SPEED SCALE ON THE PLOT
500 DIMENSION SNUM(6)
600 DATA SNUM/1460.,1480.,1500.,1520.,1540.,1560./
700 C MOVE PLOTTER TO THE STARTING POINT OF SCALE
800 XD = BASEX + 17.
900 IF (NX.LT.21) XD = BASEX + FLOAT(2 * NX) / 3. + 3.
1000 YD = BASEY - .93
1100 CALL PLOT (XD, YD, 3)
1200 C DRAW SCALE.
1300 X = 0.
1400 DO 100 Y = 1, 6
1500 CALL PLOT (XD + X, YD, 2)
1600 CALL NUMBER (XD + X - .2, YD - .25, .1, SNUM(I), 0., -1)
1700 CALL PLOT (XD + X, YD + .1, 3)
1800 CALL PLOT (XD + X, YD, 2)
1900 X = X + 1.
2000 100 CONTINUE
2100 C TITLE SCALE.

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2200 CALL SYMPOI, (XD + 1., YD + .15, .14, 24H SOUND SPEED SCALE (M/S),
2300 C 0., 24)
2400 RETURN
2500 END

SUBROUTINE SVPRD(RMAX,RMIN,R.I.DP,SPD)
C
C
C SUBROUTINE SVPRD READS SOUND VELOCITY PROFILES
C FROM TAPE2. IT DETERMINES IF THE SVP IS IN
C RANGE OF INTEREST. IF SO, IT COMPUTES THE
C GRADIENTS FOR EACH INTERVAL IN THE PROFILE AND,
C IF REQUIRED, COMPUTES THE SOUND SPEED AT YMAX.
C
C
C DIMENSION DP(100), SPD(100)
C COMMON / PLTR / BASEX, BASEY, XSCL, YSCL, YHT, YMAX, SS,
C X NIN, NOIT, NCFL, MEAS
C
C 100 CONTINUE
C READ(NCFL,1) R
C IF (R.GE.1.0F12) RETURN
C MEAS=0
C IF(R.LF.0)MEAS=1
C R=ARS(R)
C R = R / 6076.1
C READ THE PROFILE.
C READ(NCFL,1) N,(DP(I),SPD(I),I=1,N)
C IF (R.LT.RMIN) GO TO 100
C IF (R.GT.RMAX) RETURN
C METRIC = 1
C IF (SPD(1).LT.3000.) GO TO 105
C METRIC = 0
C DP(1) = .3048 * DP(1)
C SPD(1) = .3048 * SPD(1)
C 105 CONTINUE
C WRITE(MOUT,110) R,DP(1),SPD(1)
C 110 FORMAT (A40RANGE =, F8.2, 5H N.M. / 10X, 1H1, 5X, F7.1, 3X, F7.2)
C DO 130 I = 2, N

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3300 IF (METRIC.EQ.1) GO TO 115
3400 SPD(I) = .3048 * SPD(I)
3500 DP(I) = .3048 * DP(I)
3600 115 CONTINUE
3700 C
3800 G = (SPD(I) - SPD(I - 1)) / (DP(I) - DP(I - 1))
3900 C
4000 IF THE DEPTH IS GREATER THAN YMAX. EXIT THE LOOP.
4100 IF NOT, PRINT THE PROFILE POINT AND THE GRADIENT.
4200 IF (DP(I).GT.YMAX) GO TO 140
4300 WRITE(NDUT,120) I,DP(I),SPD(I),G
4400 120 FORMAT (I11, 5X, F7.1, 3X, F7.2, 3X, 1PE11.4)
4500 C
4600 THE SPEED AT YMAX HAS BEEN CALCULATED. RETURN.
4700 IF (DP(I).EQ.YMAX) RETURN
4800 130 CONTINUE
4900 C
5000 COMPUTE THE SPEED AT YMAX. THEN RETURN.
5100 I = N + 1
5200 140 CONTINUE
5300 DP(I) = YMAX
5400 SPD(I) = SPD(I - 1) + G * (DP(I) - DP(I - 1))
5500 WRITE(NDUT,120) I,DP(I),SPD(I),G
5600 RETURN
5700 END

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100 SURROUTINE SVPLT(RNG,N,DP,SPD)
200 C
300 SURROUTINE SVPLT PLOTS THE SOUND VELOCITY PROFILE
400 FOR A GIVEN RANGE POINT. IT PRINTS OUT THE SURFACE
500 SOUND SPEED.
600 C
700 COMMON / PLTR / RASEX , BASEY , XSCL , YSCL , YHT , YMAX , SS ,
800 X
900 NIN , NOUT , NCFL , MFAS
1000 DIMENSION DP(100), SPD(100)
1100 DATA SPDSCI, / .05/, SLAST / -999. /, SOFF / .14 /, SN / 0. /
1200 C
1300 COMPUTE BASE POINTS FOR PLOTTING.
1400 RASPD = (BASEX + SS + 3.) + RNG * XSCL
1500 RYSPD = BASEY + YHT
1600 C
1700 DETERMINE OFFSET FOR WRITING SURFACE SOUND
1800 SPEED, THEN WRITE IT.
1900 SOFF = SOFF + .14
2000 IF ((RYSPD - SLAST) .LT. 0.65) GO TO 100

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1700 SLAST = AXSPD
1800 SOFF = .14
1900
2000 CALL NUMMER (AXSPD - .2, BYSPD + SOFF, .1, SPD(1), 0., 1)
2100      C      PLOT SOUND SPEED CURVE.
2200 CALL PLOT (AXSPD, RYSPD + .1, 3)
2300      C
2400      C      PLOT (AXSPD + SPDSCL * (SPD(1) - SPD(1)), RYSPD - DP(T)
2500      C      * YSCL, 2)
2600      C      IF(MFAS.NE.0) CALL SYMBOL(AXSPD+SPDSCL*(SPD(1)-SPD(1)),
2700      C      X RYSPD-DP(1)*YSCL, 0.07, 2, 0.0, -1)
2800      C
2900      C      IF(MFAS.FO.0) RETURN
3000      C
3100      C      INDICATE A MEASURED (REAL) PROFILE BY NUMMERING IT
3200      C
3300      C      SN = SN + 1.0
3400      C      CALL NUMMER(AXSPD+SPDSCL*(SPD(N)-SPD(1)), RYSPD-DP(N)*YSCL+0.05,
3500      C      X 0.14,SN,0.0,-1)
3600      C      RETURN
3700      C      END

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END

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